Improving Modeling of Economic, Climate, and Energy Policy to Support CCS R&D

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Environmental Energy Technologies

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CCS in global climate policy

- **Primary analytical tools: "Integrated Assessment" (IA) models**

  - ❏ Numerical economic models coupled to reduced-form environmental models, e.g., general circulation models (GCMs)

- **Canonical output: "Scenarios"**

  - ❏ Long-run - to 2100 - simulations representing global economy and energy systems, plus key environmental feedbacks, under various assumptions
    - • Typical assumption combinations:
      - – "Reference" or "Business-as-usual," and "Policy"

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Recent U. S. DOE study of "Stabilization Scenarios"

- **Completed July 2007 (Clarke et al. 2007)**

- **Three U. S. modeling groups:**

    - MIT: "Integrated Global System Model" - IGSM

    - EPRI: "Model for Evaluating the Regional and Global Effects of GHG Reduction Policies" - MERGE

    - Pacific Northwest National Laboratory - "Mini Climate Assessment Model" - MiniCAM

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Scenarios

◆ **Each model's "Reference" and 4 policy, corresponding to increasingly stringent levels of global CO2 abatement and resulting reductions in long-run atmospheric concentrations from the Reference:**

  ❏ Level 4: 750 ppmv

  ❏ Level 3: 650 ppmv

  ❏ Level 2: 550 ppmv

  ❏ Level 1: 450 ppmv

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Results

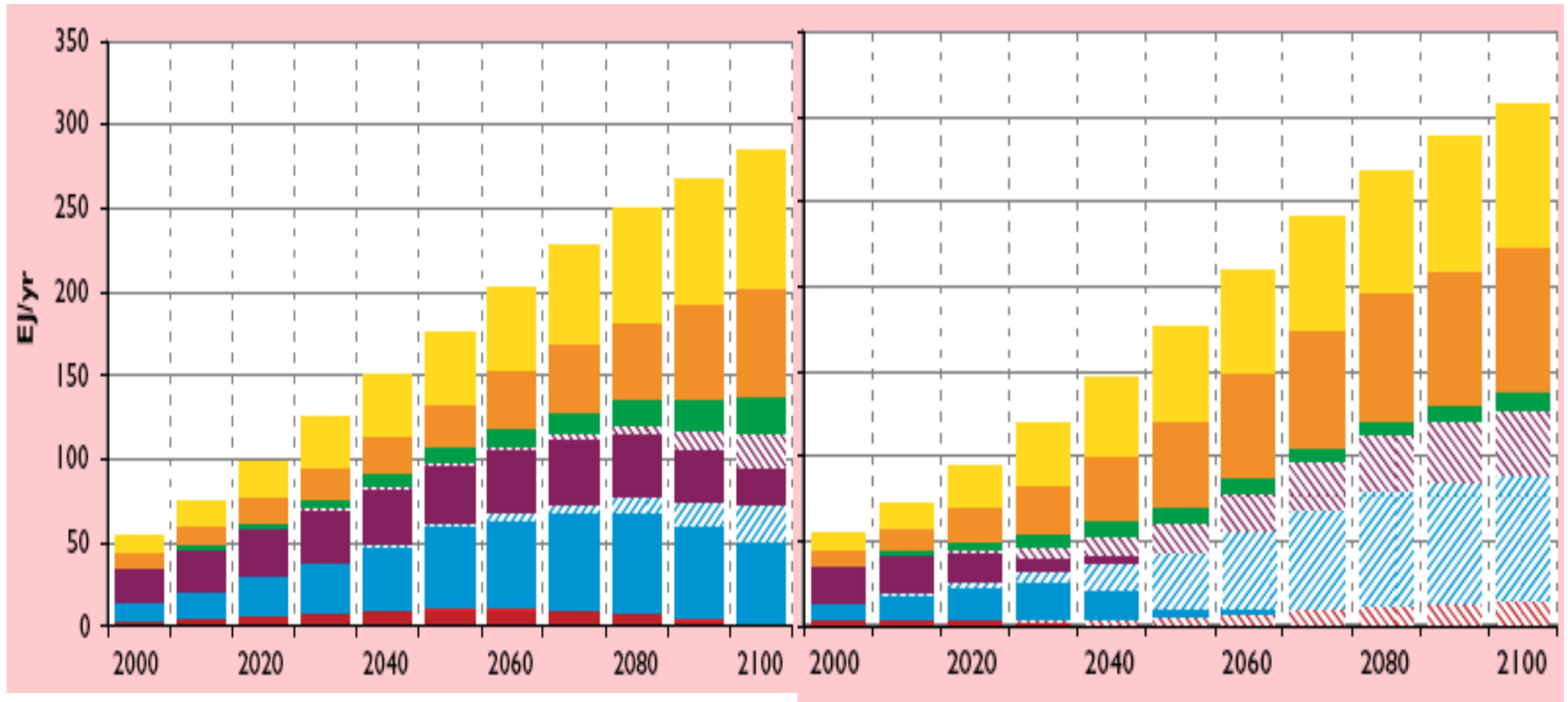- **Following graphs excerpted from Figure 4.12 - "Global Electricity Production by Fuel Across Scenarios (EJ/yr)"**
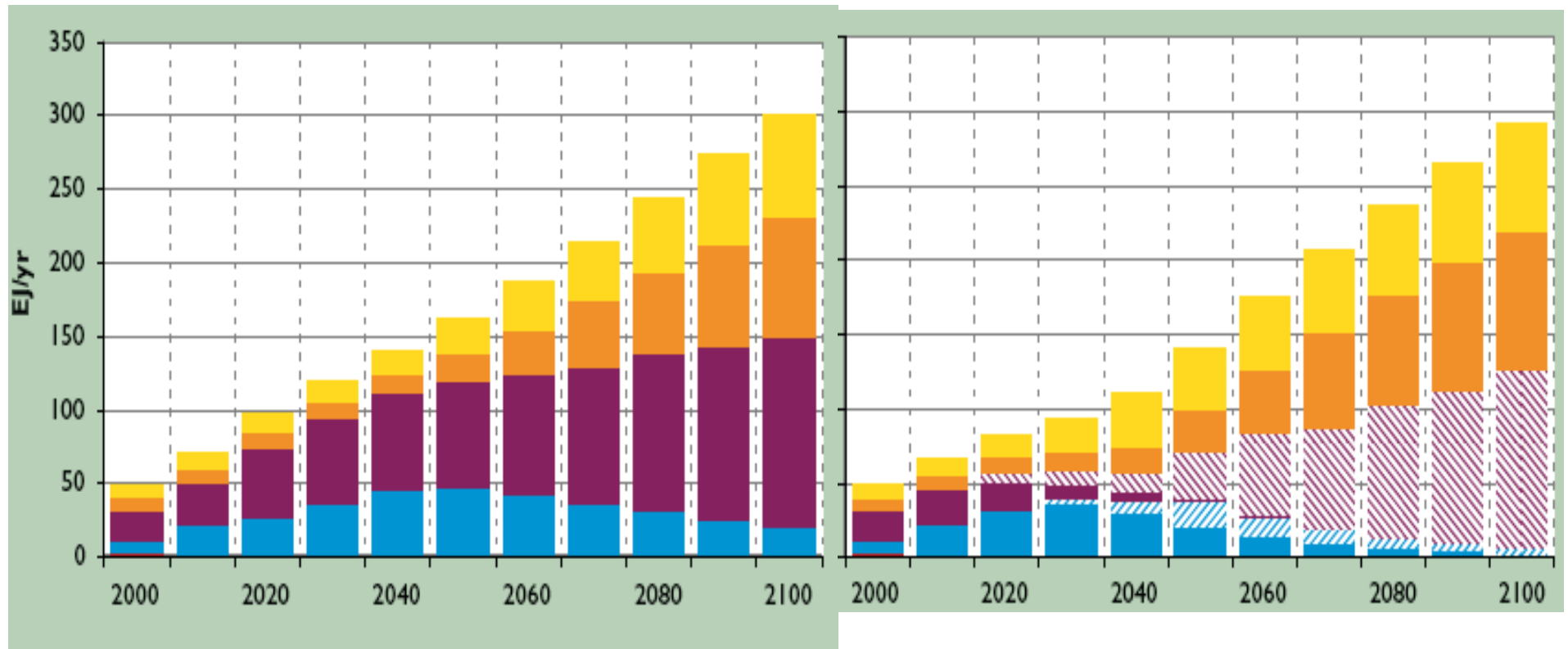 - ❑ Show Reference and Level 1 cases for each model
- **Color codes:**

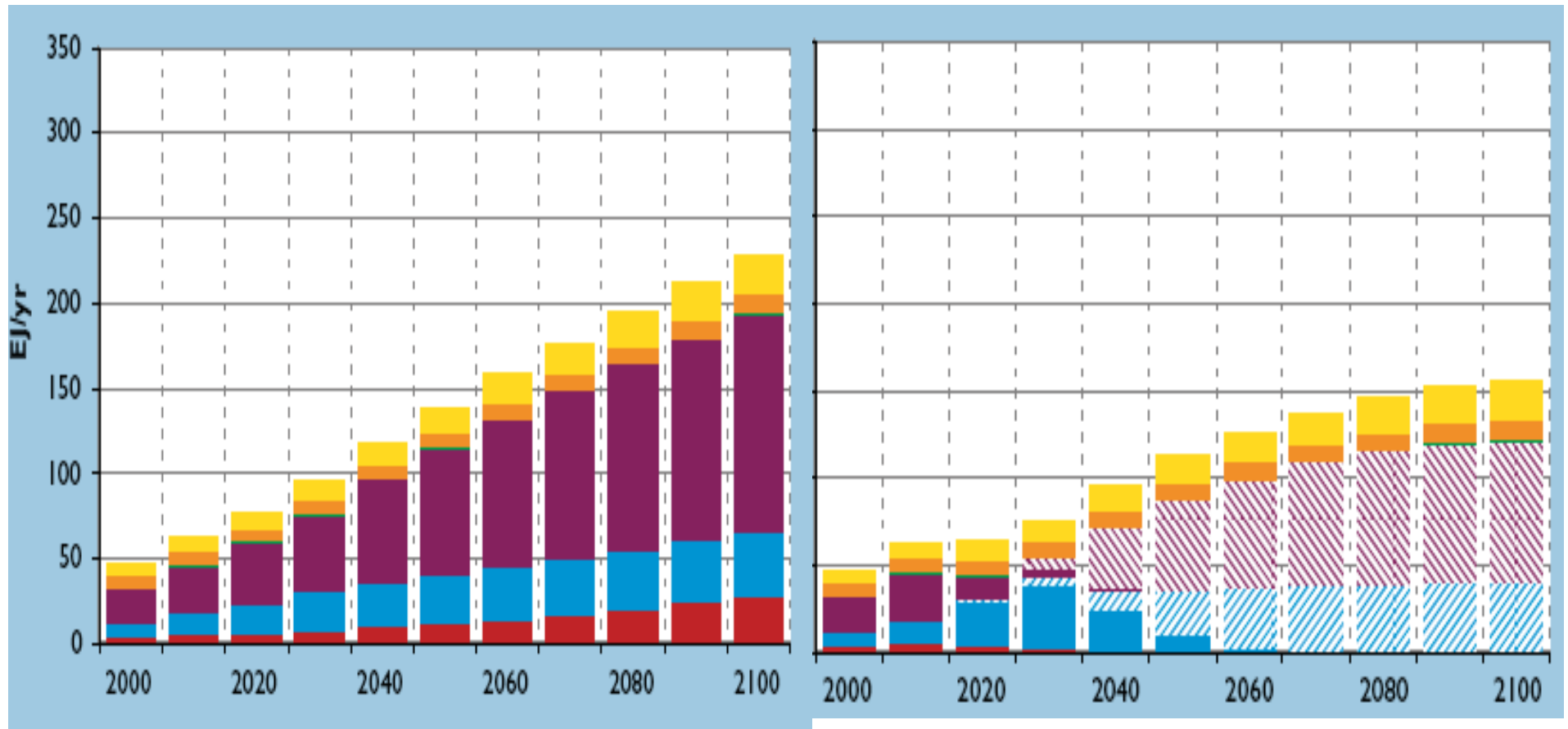|	
🟨 Non-Biomass Renewables	▨ Natural Gas: w/ CCS
🟧 Nuclear	🟦 Natural Gas: w/o CCS
🟩 Commercial Biomass	▧ Oil: w/ CCS
▨ Coal: w/ CCS	🟥 Oil: w/o CCS
🟪 Coal: w/o CCS	

MiniCAM - Reference and Level I

MERGE - Reference and Level I

IGSM - Reference and Level I

R&D-Driven Research Issues in Economic and Policy Modeling

- **Results just presented illustrate current methodology: Deterministic projections based on exogenous technology assumptions**

- **There is a need to develop and apply modeling tools with such functionalities as**

  - ❑ Explicit treatment of uncertainties of various kinds

  - ❑ Decision-analysis of research options

  - ❑ "Inverse" analysis to identify full technology pathways, from R&D, to commercialization, to full-scale deployment

  - ❑ Analysis at multiple scales

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